# Science Flight Report
# Operation IceBridge Antarctica 2010

**Flight:** **F04**
**Mission:** **LVIS86b**

## Flight Report Summary

| | |
|---|---|
| **Aircraft** | **DC-8 (N817NA)** |
| **Flight Number** | 110109 |
| **Flight Request** | 118003 |
| **Date** | Thursday, November 04, 2010 (Z), Day of Year 308 |
| **Purpose of Flight** | Operation IceBridge Mission LVIS86b |
| **Take off time** | 12:00:42 Zulu from Punta Arenas (SCCI) |
| **Landing time** | 23:49:20 Zulu at Punta Arenas (SCCI) |
| **Flight Hours** | 11.9 |
| **Aircraft Status** | Airworthy. |
| **Sensor Status** | All installed sensors operational. |
| **Significant Issues** | None |
| **Accomplishments** | • High-altitude survey (35,000 ft) of several hundred ICESat tracks along 86°S arch around South Pole from 45°W to 90°E.<br>• Completed entire mission as planned.<br>• ATM, MCoRDS, gravimeter, LVIS, POS/AV, and DMS were operated on the survey lines.<br>• Snow and Ku-band radars were not in operation on this flight due to the high altitude mission.<br>• Conducted a ramp pass at Punta Arenas airport for ATM, LVIS and DMS instrument calibration (12,000 ft AGL).<br>• Conducted pitch and roll maneuvers for LVIS calibration over Drake Passage and Strait of Magellan. |
| **Geographic Keywords** | Antarctica, Scott-Amundsen South Pole Station |
| **ICESat/CryoSat Track** | Several hundred ICESat tracks |
| **Repeat Mission** | Partial reflight of 2009 arch. |

## Science Data Report Summary

| Instrument | Instrument Operational | | | Data Volume | Instrument Issues |
|---|---|---|---|---|---|
| | Survey Area | Entire Flight | High-alt. Transit | | |
| **ATM** | ☑ | ☒ | ☒ | 7.5 GB | None |
| **MCoRDS** | ☑ | ☒ | ☒ | 2 TB | None |
| **Snow Radar** | ☒ | ☒ | ☒ | N/A | N/A |
| **Ku-band Radar** | ☒ | ☒ | ☒ | N/A | N/A |
| **LVIS** | ☑ | ☒ | ☒ | N/A | Frost on window |
| **DMS** | ☑ | ☒ | ☒ | 18 GB | Camera swap |
| **POS/AV (510 + 610)** | ☑ | ☑ | ☑ | 2 GB | None |
| **Gravimeter** | ☑ | ☑ | ☑ | 80 MB | None |
| **DC-8 Onboard Data** | ☑ | ☑ | ☑ | 40 MB | None |

### Mission Report (Michael Studinger, Mission Scientist)

Today's mission is a continuation of the LVIS86 IceBridge flight from October 25, 2009. The goal is to allow intercomparison of LVIS and ICESat altimetry over small portions of hundreds of ICESat orbits, where they are concentrated along an arch at 86°S, the inflection point of the ICESat orbits. Coincident LVIS and ICESat footprint elevation differences will be derived as a function of ICESat campaign in order to investigate the magnitude of the ICESat intercampaign biases. The repeat of a portion of the data collected in 2009 will allow an estimate of the magnitude of the annual signal to be made. The extension of the data to a previously unsampled section enables a further validation of the LVIS-ICESat vertical biases as a function of ICESat laser operation campaign and facilitates a comparison to existing LVIS-ICESat differences along ICESat tracks that were sampled in Greenland in 2009 and 2010.

Today's decision to fly was a nail biter. The AMPS model showed scattered clouds over the western part of the survey line that is the repeat segment of last year's mission. A few clear spots along this segment will be sufficient to get enough data to evaluate surface change. The rest of the arch is cloud free in the AMPS model, which is supported by the MODIS images that are several hours old. During the weather brief at the airport we were told that the entire area will be covered to 40% with scattered clouds and the remaining 60% will be overcast with no visibility of the surface. It was a difficult decision to trust the AMPS model and MODIS images more than the forecast from the met office. We have been following both, the AMPS model and the MODIS satellite imagery over the Antarctic Plateau over the past couple of days and saw generally good agreement. We decided to launch and it turned out to be the right decision. We encountered clouds in the first part of the arch as predicted by AMPS and the rest of the arch was cloud free.

At the beginning of the arch the window of the LVIS laser was building up frost on the outside, which obscured the camera and reduced the power of the laser signal. We closed the shutter, hoping that a change in airflow would melt the ice but ran out of time and had to start collecting data since we were already on the survey line. We lowered flight elevation by a few thousand feet to get a stronger surface return and were able to continue to survey, despite the reduction of laser signal power by one order of magnitude compared to normal conditions. LVIS was able to get returns over 90% of the swath.

Two other instruments performed exceptionally. The new high power ATM laser got surface returns from up to 33,000 ft AGL and was recording data along the entire arch on its first flight. The MCoRDS radar system was getting bed returns over large portions of the arch and filled a long-standing data gap in ice thickness around the South Pole area.

After we completed the arch at 90°E we did an overpass of the Amundsen-Scott South Pole Station, in order to best utilize the high-rate GPS data being collected there for our trajectory computations. We switched of all laser and radar science instruments 36 nautical miles before South Pole in order to avoid interference with any science experiments that are going on in the so called “dark sector” around South Pole Station. We flew over South Pole at 18:17:46 UTC and switched on the radars and laser again after clearing the dark sector 20 km behind South Pole.

Shortly after the South Pole we started to climb to higher flight elevation to be more fuel efficient. We also encountered clouds again as expected from the AMPS model.

**Individual instrument reports from experimenters on board the aircraft:**

**ATM:** The new high altitude ATM system worked well and collected good data on its first flight.

**MCoRDS:** The MCoRDS radar collected data over land ice with some brief interruptions due to disk swap. Good bed returns along large portions of the arch.

**Snow and Ku-band radar:** Not in operation due to high altitude mission.

**Gravimeter:** Worked well. No issues.

**DMS:** DMS worked well. Low temperatures required a camera swap. Occasional clouds obscured the surface.

**LVIS:** The LVIS system worked well. A frost layer on the outside of the window impacted the performance of the system, but LVIS acquired range data over the cloud free portions of the arch and was able to get surface returns of 90% of the swath.

**POS/AV:** Systems worked well. No issues.

**DC-8 on board data:** System worked well.


Figure 1: Nav station of the DC-8 N817NA a few seconds before flying over the geographic South Pole.

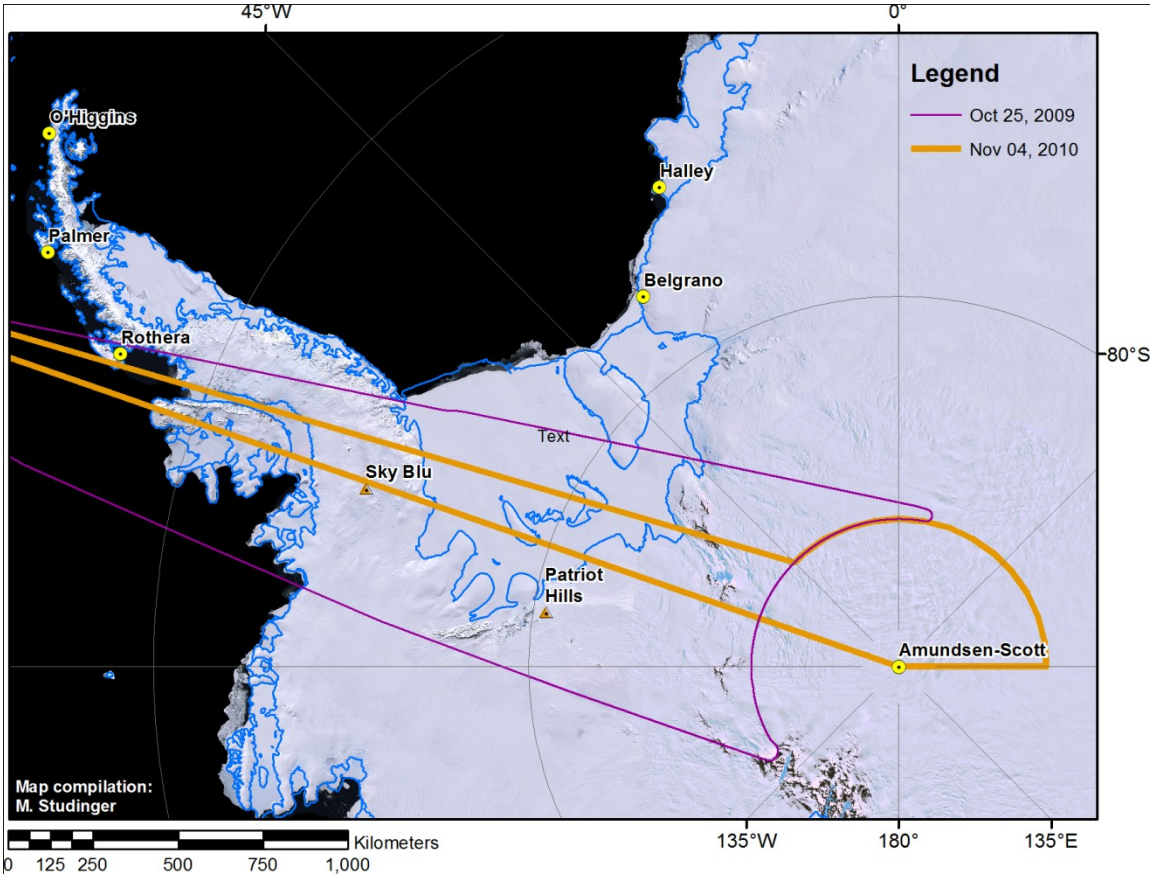


Figure 2: Flight paths of both, today's and last year's South Pole mission.

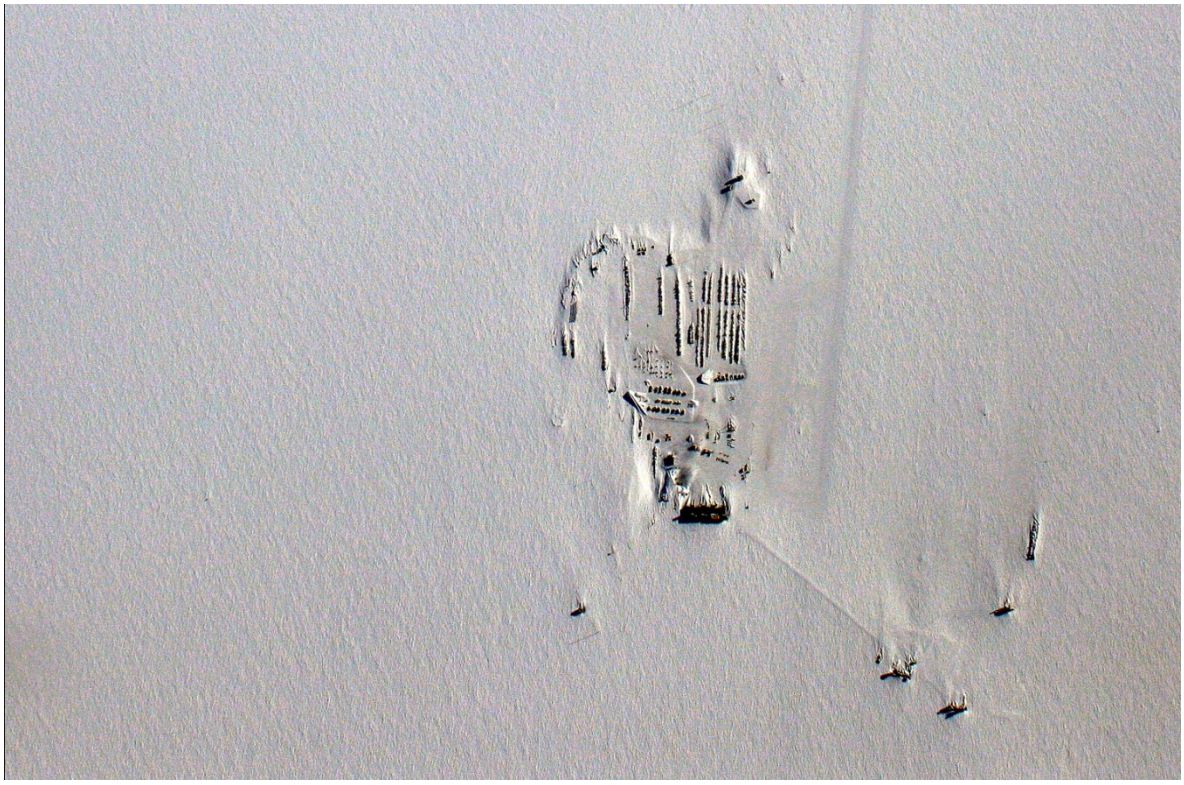

Figure 3: DMS photo of Scott-Amundsen South Pole Station.